SAN097-0893A

CALCULATION OF POPULATION DOSES WITH RADTRAN FOR ROUTE SEGMENTS THAT HAVE AN UNPOPULATED NEAR-FIELD REGION

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RADTRAN transportation accident-risk calculations are usually performed by dividing a transportation route into segments (links) and then calculating the population dose and number of expected cancer fatalities that might occur among the population located along the link should an accident occur while the Radioactive Material (RAM) transport vehicle is traversing the link. Because the link population is modeled using a uniform population density out to some user-specified distance from the route (typically 50 mi), if the near-field region along the route is lightly populated or unpopulated, the use of an average population density artificially moves population located away from the route to positions closer to the route, thereby artificially increasing estimates of population dose and radiation induced cancer fatalities. For RADTRAN calculations that examine routes which have been divided into three aggregate links (one urban, one suburban, and one rural aggregate link), because the aggregate links always have fairly uniform population densities, use of uniform population densities for the three aggregate links is appropriate. However, when a highway or rail route is divided into many links, some of which have lightly populated or unpopulated near-field regions, or when radioactive material is transported by sea along coastal routes, which are typically sailed at distances of several tens of miles from the shore, use of uniform link population densities may cause consequences to be significantly overestimated. Therefore, a way to perform RADTRAN calculations, that allows an unpopulated near-field region along a transportation link to be approximately modeled, has been developed and validated.

The transportation scenario examined was the maritime shipment of spent fuel along the East Coast of the United States on a freighter sailing at a distance of 30 miles from the coast. To capture the effect of the 30-mile-wide, near-field region of open ocean that is devoid of population, two RADTRAN calculations were performed, one 0 to 50 mile calculation, and one 0 to 30 mile calculation, and their results were differenced, thereby obtaining the results from 30 to 50 miles. The results of this computational procedure were compared to the results of a MACCS calculation, because MACCS uses a population distribution that is specified on a polar-coordinate grid which can have grid cells that are unpopulated. By specifying that all MACCS grid cells with outer radial boundaries of 30 miles or less were unpopulated, population doses for the population located beyond 30 miles were directly calculated. Because the RADTRAN and MACCS calculations used the same uniform population density, source terms, and meteorological conditions, the fact that the population dose obtained by differencing the two RADTRAN calculations agrees within a factor of two with the population dose calculated by MACCS indicates that differencing two RADTRAN calculations is an appropriate way to model a link with an unpopulated near-field region.

* Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin company, for the United States Department of Energy under contract DE-AC04-94AL85000